

The Physical, Biological and Chemical Characterization of Micro-particulates from the Middle East

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Acknowledgements

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Corp of Engineers

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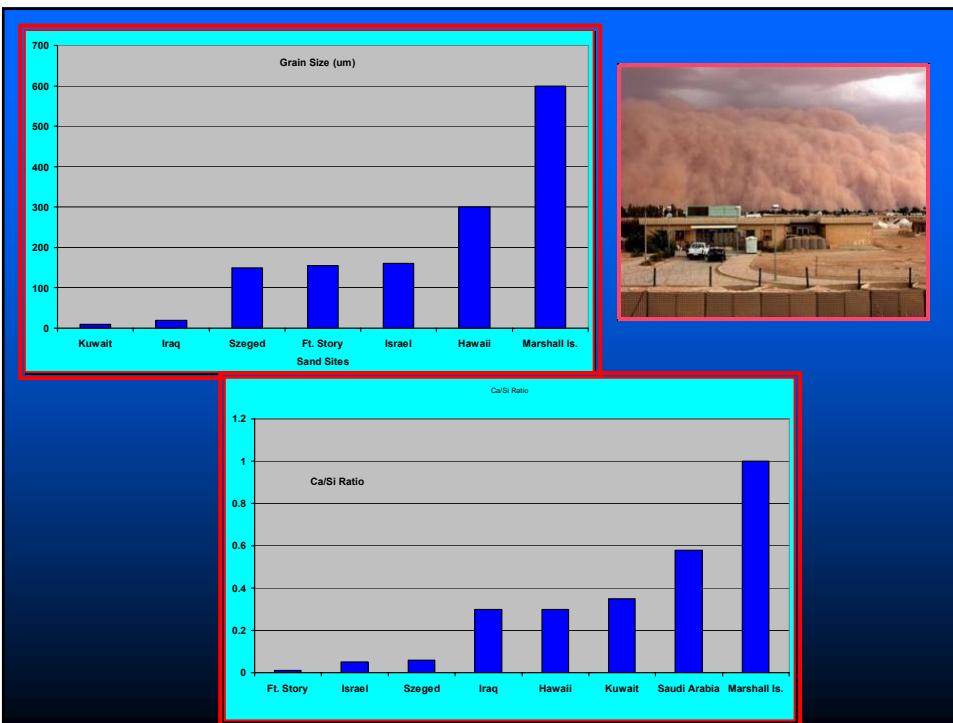
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Background

- Dust sample arrives from Iraq October 2003 for ADAL project.
- Scanning Electron Micrograph and Fluorescent Microscopy analysis of dust sample indicates: 1) significant micro-particulate concentration (<20 μm), 2) micro-particulates are not crystalline or are coated, and 3) particles exhibit unique physical properties.
- Pneumonia and other respiratory health problems among US military personnel in the US Central Command Area of Responsibility (USCENTCOM AOR). Significant post-operative infection rate among U.S. and coalition wounded.
- Exposure of airborne micro-particulates, especially during duststorms, is ubiquitous for all coalition forces.
- Information passed to ONR which funds a pilot project.





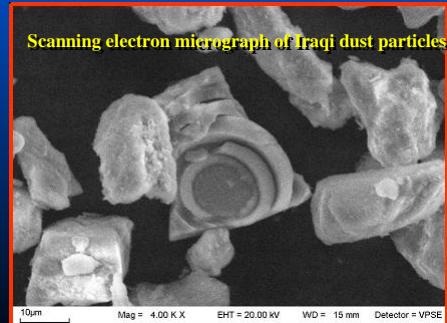
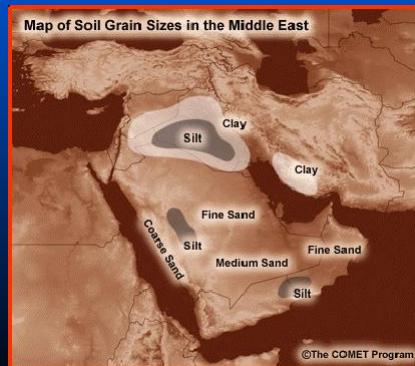
Soils of Lower Mesopotamia



20-60% of surface soil mass is comprised of particles < 2.5 µm in size (PM_{2.5})

As, Cr, Pb, Os are elevated

Silicate mineral component mixed with significant proportions of calcium carbonate



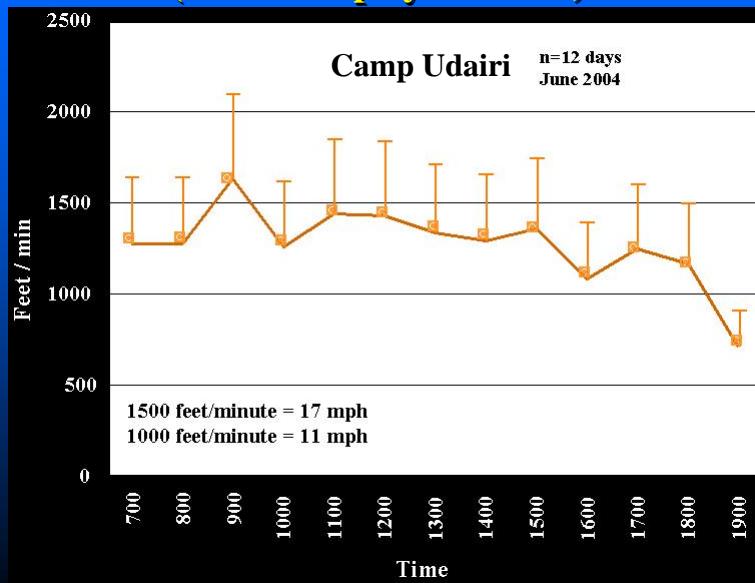
History / Review of Literature

- ❖ Iraqi soils contain concentrations of Chromium up to 2272 ppm. (A. Gindy *et al.*, Petrography and petrochemistry of some zagroside geosynclinal calcarenites from north-eastern Iraq, *Sedimentary Geology*, **42**, (1985), p.279)
- ❖ Evidence of microbial transfer of pathogens via African Dust. (EA Shinn, *et al.*, African Dust and the Demise of Caribbean Coral Reefs, *Geophys Res Lett*, **27**, (2001) p.3027-32)
- ❖ Description of novel condition triggered by exceptionally fine sand of the central and eastern Saudi Arabian peninsula. Concludes that immunosuppression aggravated by opportunistic infections and other non-microbial ailments brought on by exposure to the ubiquitous fine sand of the area cause Persian Gulf Syndrome. (Korenyi-Both, *et al.*, Al Eskan Disease: Persian Gulf Syndrome, *Military Medicine*, **162**, (1997), p.001).
- ❖ Obstructive bronchitis and bronchiolitis in 86 autopsied casualties from Kuwait, with observation of sand particle in lung parenchyma. (NS Irey, Kuwait Casualties: Morphologic and Toxicologic Findings, NIH Technical Assessment Statement, April 27-29, 1994).
- ❖ From March through August 2003, 19 US military personnel developed pneumonia severe enough to warrant medical evacuation and mechanical ventilation; two died. (AF Shorr, *et al.*, Acute eosinophilic pneumonia among US military personnel deployed in or near Iraq, *JAMA*. 2004 Dec 22;292(24):2997-3005.)

Specific Aims

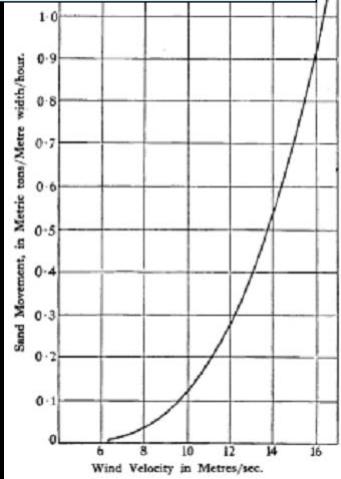
- ✓ Scientifically collect and process sand/dust samples for transport back to CONUS for further testing.
- ✓ Characterize the sand/dust environment.
- ✓ Physically characterize samples as to particle size distribution and concentration, and other physical qualities.
- ✓ Chemically analyze samples based on size fraction as to elemental content and concentration as well as poly-anion and cation identification.
- ✓ Biologically characterize samples based on size fraction as to anaerobic/ aerobic bacterial populations, yeasts, fungi, and viruses. Special identification of known pathogens.

Average Hourly Wind Velocity (Kuwait Deployment Site)



Wind Velocity & Airborne Dust

$$10 \text{ m/s} = 1968 \text{ ft/min} = 22 \text{ mph}$$
$$16 \text{ m/s} = 3149 \text{ ft/min} = 36 \text{ mph}$$

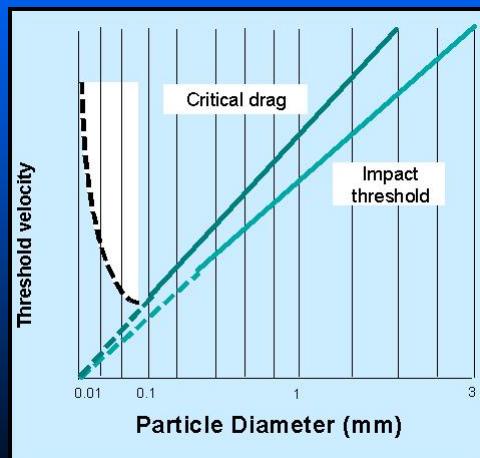


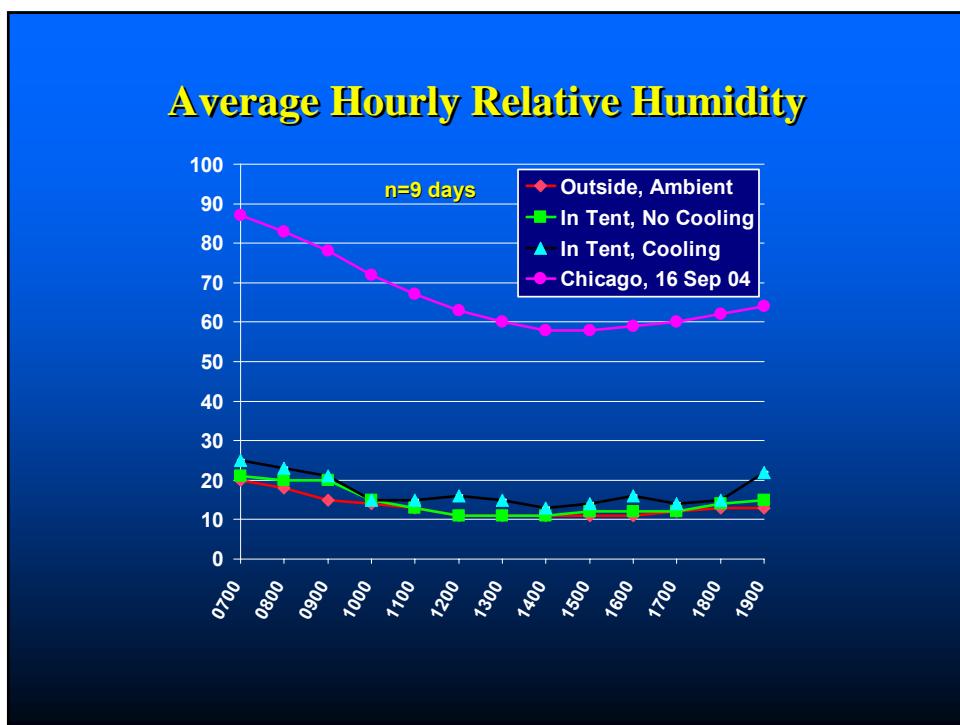
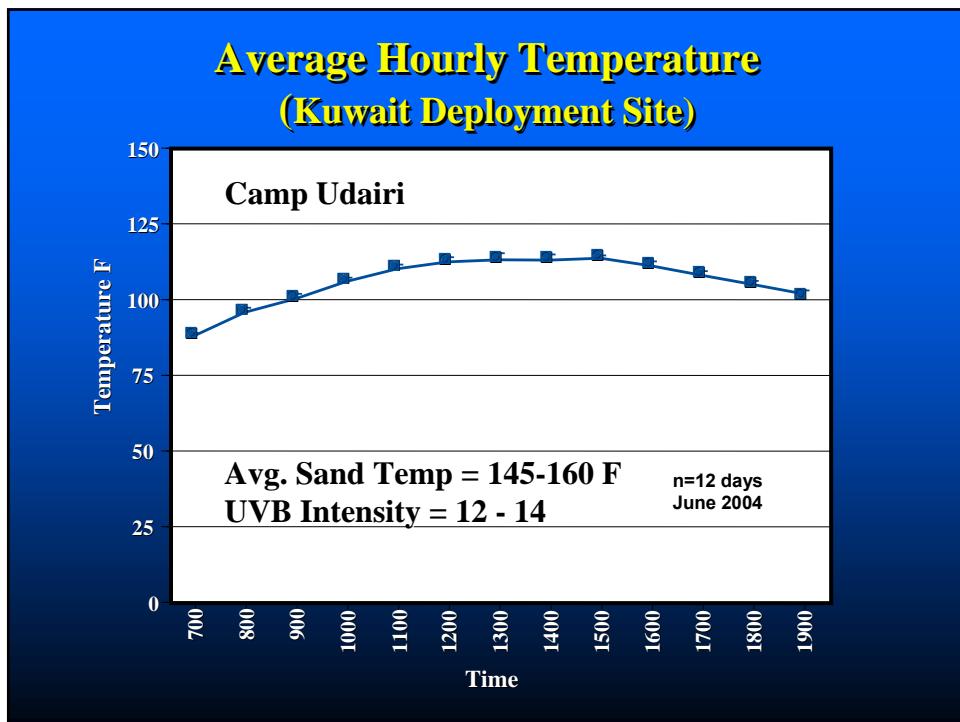
Aerodynamics of Wind Particles

Air flow may be laminar or turbulent, but any near-surface flow is turbulent because of ground roughness.

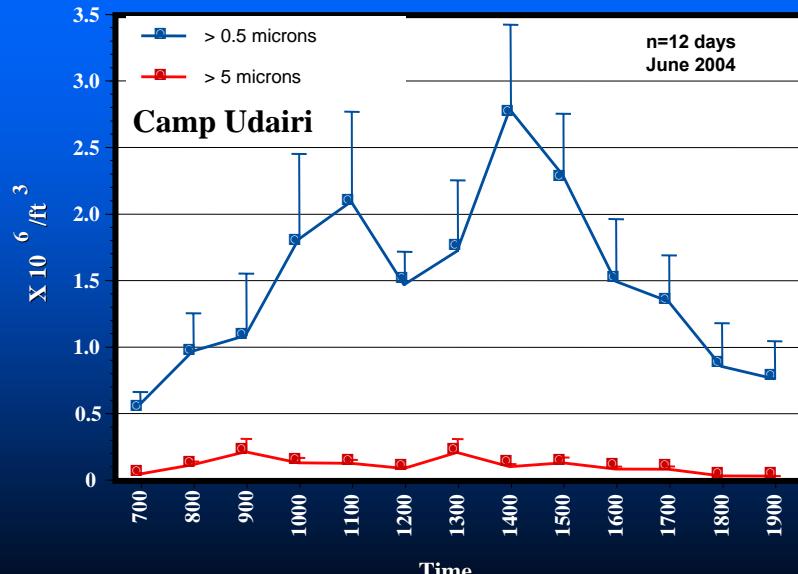
$$\text{Velocity} = 5.75 V_d \log z/k$$

Wind erosion occurs at the instant that a grain is moved. Movement begins when the critical drag velocity is reached for a given size particle.

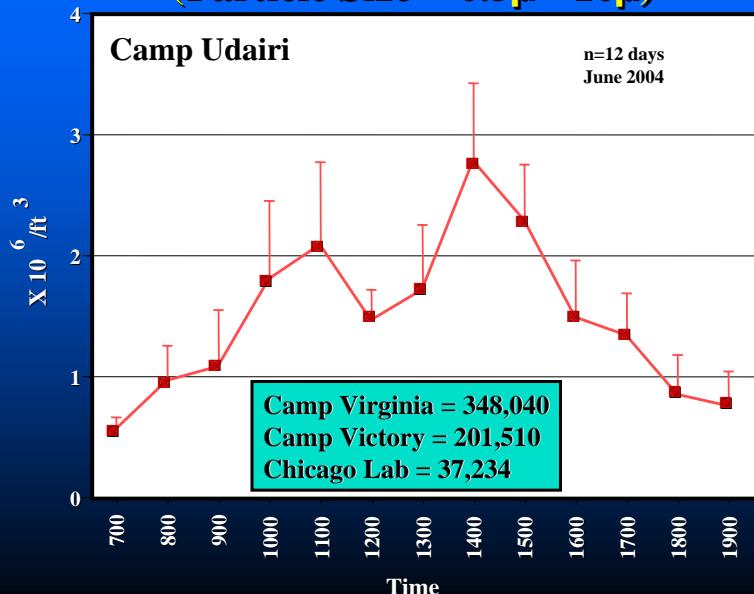




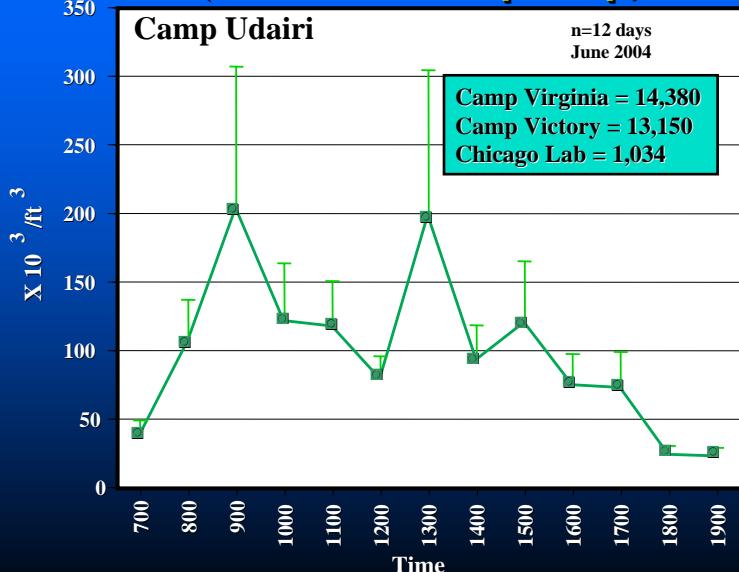
Mean Ambient Airborne Particle Counts



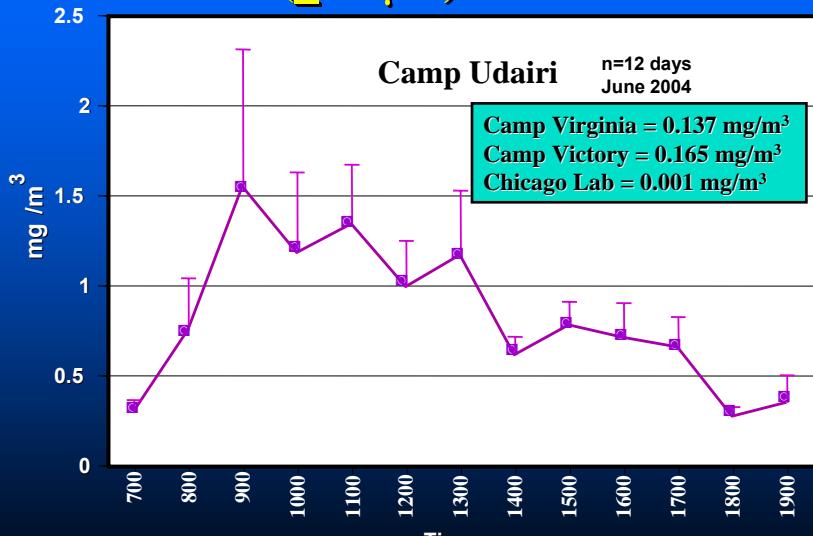
Mean Ambient Airborne Particle Count (Particle Size = $0.5\mu - 10\mu$)



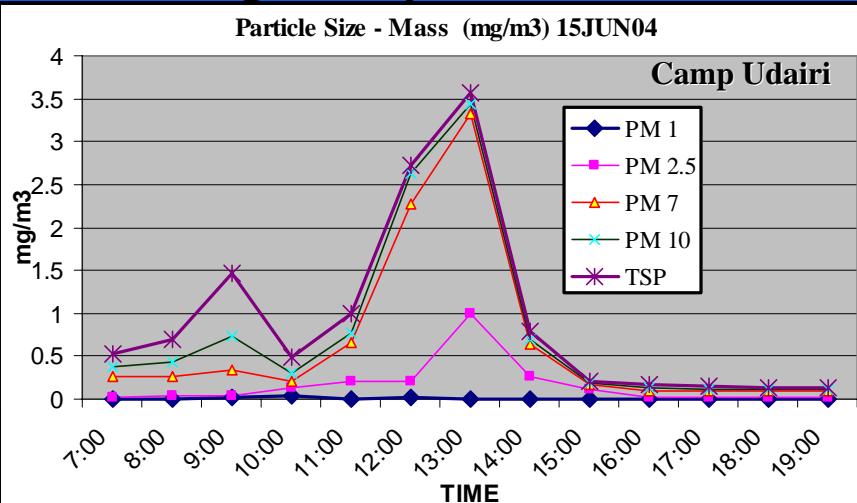
Mean Ambient Airborne Particle Count (Particle Size $5.0\mu - 10\mu$)



Mean Total Suspended Particle Mass PM 10 ($\leq 10 \mu\text{m}$) in Ambient Air



Average Suspended Particle Mass (mg/m³) by Particle Size



Summary

TSP (Total Suspended Particle Mass) (mg/m³) PM10 (10 µm) and below

- = 0.001 mg/m³ (NIDBR Lab, Great Lakes, IL)
- = 0.137 mg/m³ (Camp Virginia Clinic, Kuwait - indoors)
- = 2.469 mg/m³ (Highest hourly average - 8 AM)
- = 9.114 mg/m³ (Highest TSP reading)
- = 2.051 mg/m³ (Highest daily maximum - 18 June at 1300)

* NOTE: >9,999,999 mg/m³ readings recorded during peak dust storms

Count (Total Number of Suspended Particles) (/ft³)

Size Range = 0.5 µm to 10 µm

- = 37,234 /ft³ (NIDBR Lab, Great Lakes, IL)
- = 348,040 /ft³ (Camp Virginia Clinic, Kuwait - indoors)
- = 3,037,298 /ft³ (Highest average hourly maximum at 1300) (SD = 1,556,266/ft³)
- = 16,668,250 /ft³ (Highest daily maximum - 18 June at 1300)
- = 3,614,455 /ft³ (Highest average daily (0700-1900) maximum 13 June) (SD = 971,589/ft³)

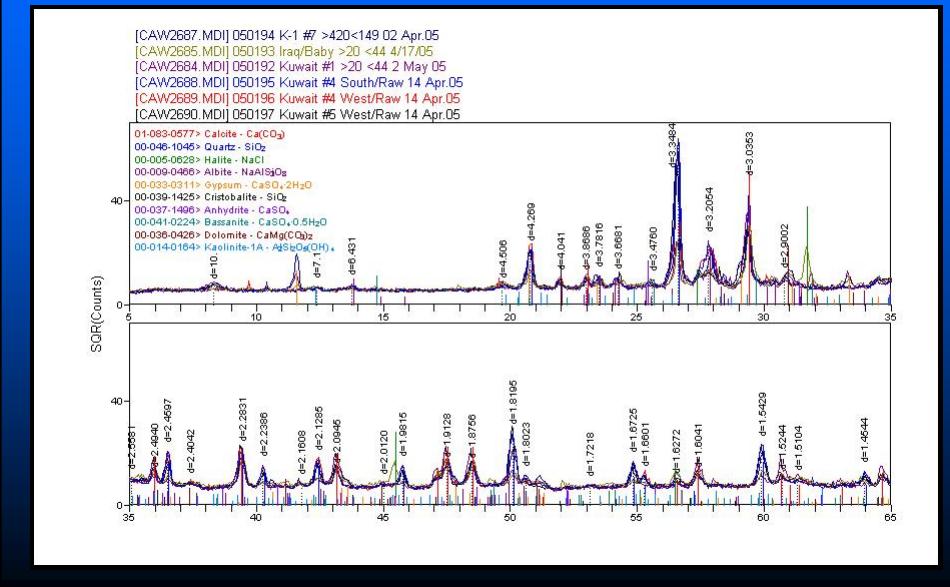
* NOTE: >20,000,000 counts /ft³ readings recorded during peak dust storms

Size Range = 5.0 µm to 10 µm

- = 1,034 /ft³ (NIDBR Lab, Great Lakes, IL)
- = 14,380 /ft³ (Camp Virginia Clinic, Kuwait - indoors)
- = 194,945 /ft³ (Highest average hourly maximum at 1300) (SD = 117,305/ft³)
- = 1,262,120 /ft³ (Highest daily maximum - 18 June at 1300)
- = 148,512 /ft³ (Highest average daily maximum - 13 June) (SD = 102,861/ft³)

NOTE: 1 cu ft = 28.31685 Liters = 0.02831685 m³

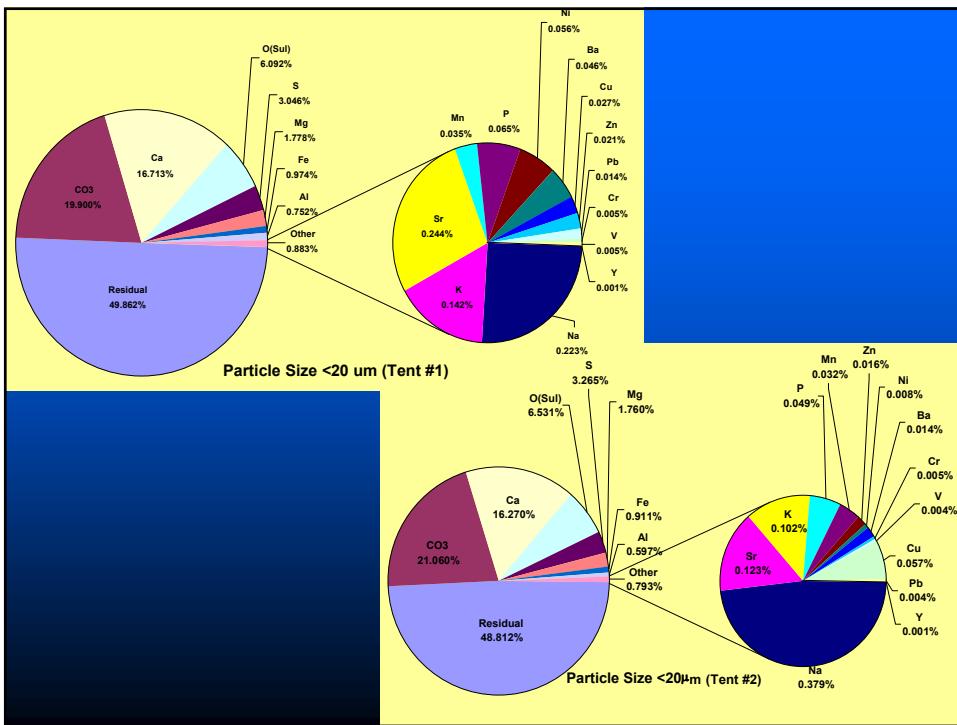
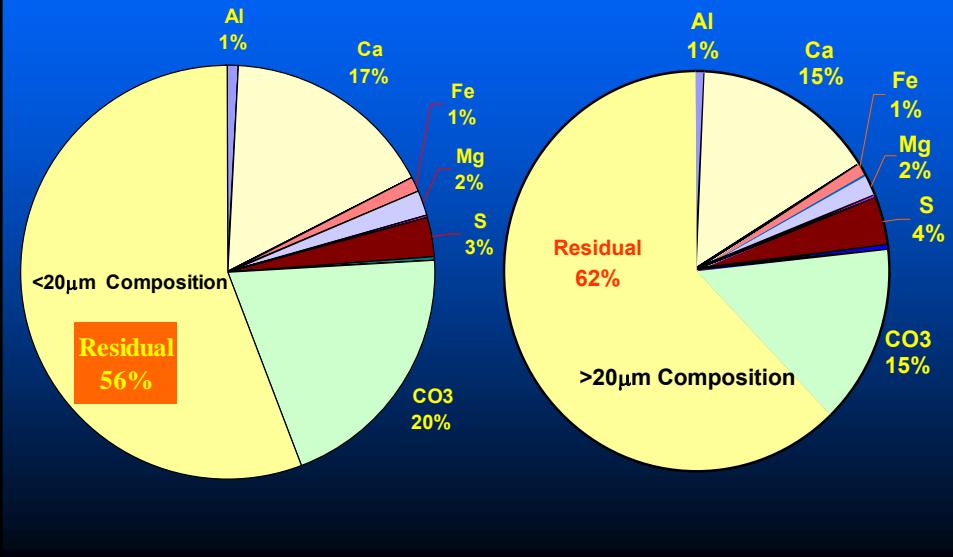
Iraqi & Kuwaiti Soils



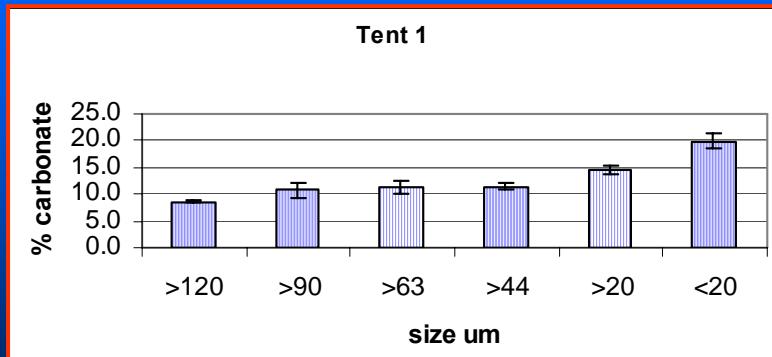
Analytical Chemistry Protocols

- A modified EPA SW-846 method 3051 digestion procedure was used for the acid extraction of metals from the dust samples.
- Digestates were analyzed for metals by Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES), Inductively Coupled Plasma Mass Spectrometry (ICP-MS), or Graphite Furnace Atomic Absorption Spectroscopy (GF-AAS), according to EPA methods 6010B, 6020, and 7000 series, respectively.
- Qualitative Analysis was performed by ICP-AES scan and the following elements examined: Be, Na, Mg, Al, Si, P, S, K, Ca, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Sr, Y, Mo, Ag, Cd, Sn, Sb, Ba, Os, Hg, La, Tl, Pb, U.
- Elements that were determined to be greater than the blank (2-3x base) were further analyzed quantitatively. Calibration and verification standards were NIST-traceable.
- The instrumentation was as follows: ARL 3560 ICP-AES and a Perkin Elmer Elan 6000 ICP-MS. An internal standard was used for all ICP-AES analyses.
- Metals concentrations for the samples are reported at the laboratory reporting limits, determined by the EPA methods used for analysis.
- All QC samples (NIST and LCS) were within limits of their accepted values, and digestion blanks were below instrument detection limits.

Chemical Analysis: <20 µm Particle VS >20 µm Particle



Chemical Analysis: Carbonates



Chemical Analysis: Heavy Metals

SAMPLE ID	KUW_BUE_PM10_04166	JW_BUE_PM10_04168	JW_BUE_PM10_04169
LOCATION DESCRIPTION	Camp Buehring	Camp Buehring	Camp Buehring
COUNTRY	Kuwait	Kuwait	Kuwait
FILTER NUMBER	47-04-127	47-04-134	47-04-136
OPERATION	OIF	OIF	OIF
COLLECTION DATE	14-Jun-04	16-Jun-04	17-Jun-04
PARAMETERS	UNITS		
PARTICULATE MATTER (PM)	<10 µm		
Particulate Matter (PM ₁₀)	µg/m ³	260.662	98.467
HEAVY METALS			
Antimony	µg/m ³	BDL	BDL
Arsenic	µg/m ³	BDL	BDL
Beryllium	µg/m ³	BDL	BDL
Cadmium	µg/m ³	BDL	BDL
Chromium	µg/m ³	0.040	0.093
Lead	µg/m ³	BDL	BDL
Manganese	µg/m ³	0.166	0.599
Nickel	µg/m ³	BDL	BDL
Vanadium	µg/m ³	BDL	BDL
Zinc	µg/m ³	BDL	BDL

Sample taken by MiniVol inside of Tent #1 by Air Force PM Team

**Chemical
Analysis:
Heavy Metals**

Acid Extractables
Tent #1

Sample	>120um	>90um	>63um	>44um	>20um	<20um
Mass	0.2627	0.2596	0.2488	0.2626	0.2441	0.2504
Element	% dry wt	%dry wt	%dry wt	%dry wt	%dry wt	%dry wt
Sr	0.0697	0.0642	0.0995	0.1978	0.2718	0.2436
Ba	0.0068	0.0072	0.0081	0.0192	0.0308	0.0463
P	0.0160	0.0170	0.0234	0.0433	0.0549	0.0649
S	2.4413	2.4230	3.0444	4.0062	3.6646	3.0458
Mg	0.6844	0.8718	1.2672	1.5505	1.7234	1.7784
V	0.0022	0.0026	0.0032	0.0041	0.0046	0.0049
Na	0.1759	0.1963	0.1672	0.2056	0.2123	0.2225
Al	0.2969	0.3832	0.4948	0.6351	0.7164	0.7521
Ca	9.0134	10.3057	11.7495	13.9148	15.3535	16.7133
Zn	0.0053	0.0039	0.0042	0.0070	0.0112	0.0206
Cu	0.0060	0.0050	0.0036	0.0054	0.0077	0.0268
Ni	0.0089	0.0094	0.0169	0.0197	0.0305	0.0564
Y	0.0009	0.0006	0.0006	0.0007	0.0009	0.0010
K	0.0502	0.0653	0.0612	0.0942	0.1186	0.1422
Mn	0.0174	0.0222	0.0268	0.0305	0.0331	0.0352
Fe	0.3506	0.4844	0.6889	0.8419	0.9601	0.9736
Cr	0.0027	0.0032	0.0039	0.0049	0.0052	0.0052
Pb	0.0111	0.0038	0.0049	0.0056	0.0076	0.0138

**Chemical
Analysis:
Heavy Metals**

Acid Extractables
Tent #1

Mass	0.2627	0.2596	0.2488	0.2626	0.2441	0.2504
Element	PPM	PPM	PPM	PPM	PPM	PPM
Sr	697	642	995	1978	2718	2436
Ba	68	72	81	192	308	463
P	160	170	234	433	549	649
S	24413	24230	30444	40062	36646	30458
Mg	6844	8718	12672	15505	17234	17784
V	22	26	32	41	46	49
Na	1759	1963	1672	2056	2123	2225
Al	2969	3832	4948	6351	7164	7521
Ca	90134	103057	117495	139148	153535	167133
Zn	53	39	42	70	112	206
Cu	60	50	36	54	77	268
Ni	89	94	169	197	305	564
Y	9	6	6	7	9	10
K	502	653	612	942	1186	1422
Mn	174	222	268	305	331	352
Fe	3506	4844	6889	8419	9601	9736
Cr	27	32	39	49	52	52
Pb	111	38	49	56	76	138

Sample	<20um	Soils	$\leq 10 \text{ }\mu\text{m}$
Mass	Tent 1	World	Daily Dose
Element	PPM	Avg. PPM	mg
Sr	2436	200	73.1
Ba	463	430	
P	649	600	
S	30458	700	
Mg	17784	5000	
V	49	100	1.47
Na	2225	6,300	
Al	7521	71,000	
Ca	167133	13,700	
Zn	203	50	
Cu	268	30	
Ni	564	40	16.9
Y	10	50	
K	1422	8,300	
Mn	352	600	10.6
Fe	9736	38,000	
Cr	52	100	1.56
Pb	138	10	4.1

Particles $\sim 250 \text{ }\mu\text{m}$ are airborne at 15 MPH to a level.

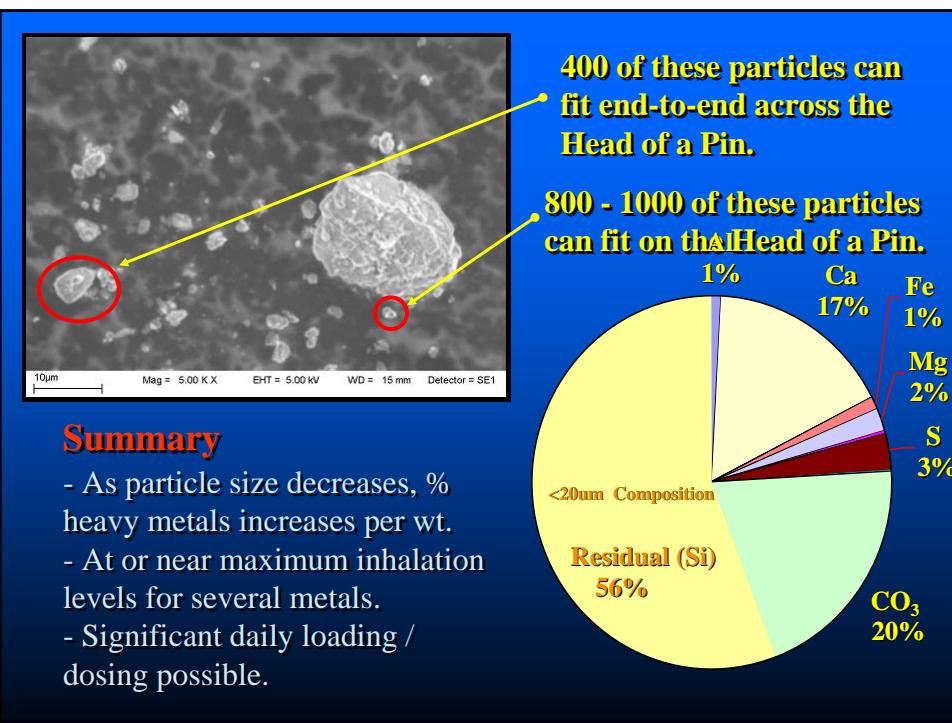
20-40 μm deposited in nose, throat, trachea.

20-10 μm deposited in all upper airways of the lung.

$\leq 10 \mu\text{m}$ deposited in lowest airways of lungs.

98% of Tent Dust is less than 149 μm .

$\sim 60\%$ of Sand Samples are less than 149 μm ..





Culturettes



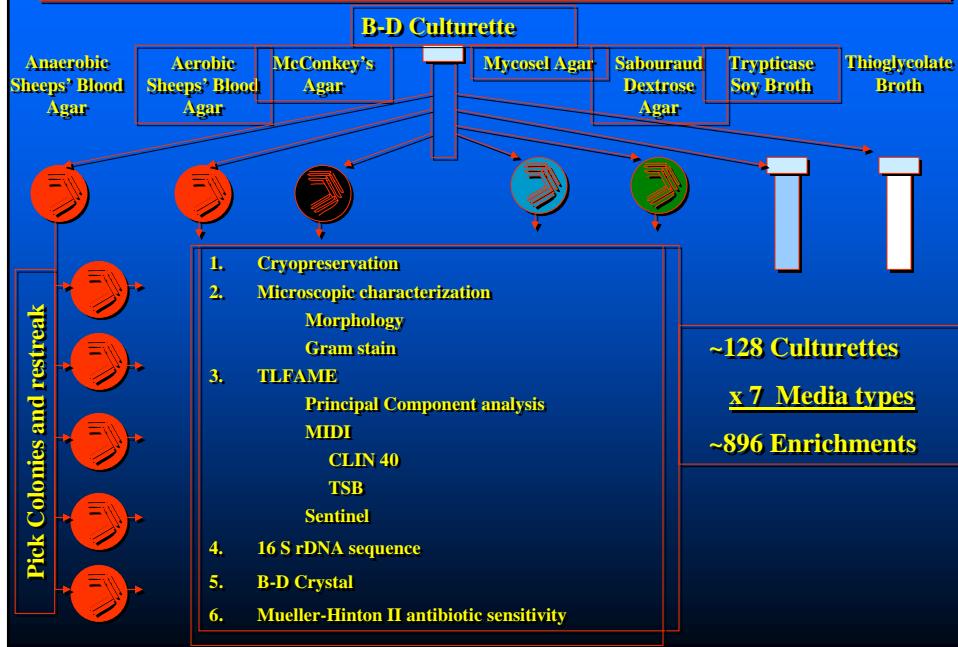
~32 samples X 6 types of Culturettes = ~192 Culturettes



- Black Aerobic & Anaerobic with Charcoal
Blue Aerobic & Anaerobic without Charcoal
Green Industrial quality control
Mico Fungi
Yellow Chlamydia
Green Virus } Stored at 3°C

~32 samples X 4 types of Culturettes = ~128 Culturettes

Microbial Isolation and Characterizations



No.	Site	Hemolys/s on Blood agar	MIDI @ DE Environmental Database ID	immiar! Index	MIDI @ MS CLM 40 Database ID	immiar! Index	MIDI @ MS Sentinel Database ID	immiar! Index	MIDI 500 bp rDNA sequence analysis % Difference	Best ID thus Far
2	Babylon	No	Pseudomonas stutzeri	0.597	Pseudomonas stutzeri	0.503	Neisseria meningitidis	0.357		<i>Neisseria meningitidis</i>
							Neisseria meningitidis	0.29		
							Neisseria cinerea	0.29		
5	Babylon	No	Staphylococcus epidermidis	0.827	Staphylococcus aureus	0.676	Staphylococcus aureus	0.609		<i>Staphylococcus aureus</i>
			Staphylococcus epidermidis	0.78	Staphylococcus warneri	0.598	Staphylococcus epidermidis	0.576		
			Staphylococcus capsulatus	0.753	Staphylococcus aureus	0.569	Staphylococcus hominis	0.497		
8	Babylon	No	Bacillus circulans	0.61	No match/Too dilute	N/A	No match			<i>Bacillus circulans</i>
9	Udairi	Alpha hemolyt	Not sent to MIDI	N/A	Not Extracted	N/A				None
10	Udairi	Alpha hemolyt	Esringella americana	0.778	Neisseria cinerea	0.204	Providencia retigera	0.023	Pantoea agglomerans	0.95% Species: <i>Pantoea agglomerans</i>
			Esromonas typhimurium	0.652	Neisseria venenata	0.179	Proteobacter denovii	0.016		
			Pantoea agglomerans	0.568	Neisseria cinerea	0.169	Erwinia amylovora	0.017		
11	Udairi	Alpha hemolyt	Pseudomonas stutzeri	0.896	Not Extracted	N/A	Pseudomonas agricola	1.34%	Genus: <i>Pseudomonas agricola</i>	
			Pseudomonas balearica	0.659						
			Pseudomonas resinovorans	0.584						
12	Udairi	No	Not growing when others	N/A	Vibrio alginolyticus	0.366	Ralstonia paucula	0.127		<i>Ralstonia paucula</i>
			Aeromonas hydrophila	0.366	Erwinia maltovora	0.103				
			Neisseria mucosa	0.338	Ralstonia basiliensis	0.1				
14	Udairi	No	Not growing when others	N/A	Staphylococcus epidermidis	0.419	Staphylococcus pasteurii	0.207		<i>Staphylococcus pasteurii</i>
					Staphylococcus caprae	0.185				
					Staphylococcus warneri	0.136				
15	Udairi	No	Vibriobacillus pentothalicus	0.677	Bacillus coagulans	0.432	Arthrobacter atrocyaneus	0.414	Arthrobacter crystallopiletes	0.00% Species: <i>Arthrobacter crystallopiletes</i>
			Micrococcus luteus	0.499	Demobacter hominis	0.327	Agronmyces remosus	0.283		
			Bacillus atrophaeus	0.477	Kocuria varians/Micrococcus	0.316				
16	Udairi	No	Staphylococcus warneri	0.881	Pseudomonas stutzeri	0.44	Pseudomonas balearica	0.097		<i>Pseudomonas balearica</i>
			Staphylococcus epidermidis	0.754	N/A	N/A				
			Staphylococcus epidermidis	0.61	N/A	N/A				
17	Udairi	Beta/Alpha	Paenibacillus thiaminolyticus	0.534	Not Extracted	N/A	Paenibacillus thiaminolyticus	2.97%	Genus: <i>Paenibacillus thiaminolyticus</i>	
			Bacillus atrophaeus	0.464						
18	Udairi	Beta hemolyt	Bacillus subtilis	0.901	Bacillus subtilis	0.52	Bacillus vedderi	0.656		<i>Bacillus vedderi</i>
			Bacillus atrophaeus	0.697	N/A	N/A	Bacillus mojavensis	0.642		
							Bacillus atrophaeus	0.471		
19	Udairi	Beta/Alpha	Bacillus subtilis	0.918	Not Extracted	N/A	Bacillus subtilis subtilis	0.00%	Species: <i>Bacillus subtilis subtilis</i>	
			Bacillus atrophaeus	0.687						
20	Udairi	alpha hemolyt	Pantoea agglomerans	0.82	Pantoea agglomerans	0.623	Ralstonia eutropha	0.274	Pantoea agglomerans	0.85% Species: <i>Pantoea agglomerans</i>
			Pantoea agglomerans	0.711	Aeromonas hydrophila	0.356	Burkholderia gaviniense	0.175		
			Salmonella typhimurium	0.683		N/A	Ralstonia basiliensis	0.166		
21	Udairi	No	Not sent to MIDI	N/A	Not Extracted	N/A	Pseudomonas pseudoalcaligenes	0.77%	Species: <i>Pseudomonas pseudoalcaligenes</i>	
22	Udairi	No	Cryptococcus albidus	0.89	Not Extracted	N/A	Cryptococcus albidus	0.00%		<i>Cryptococcus albidus</i>
			Cryptococcus neoformans	0.888						
23	Udairi	No	Bacillus alcalophilus	0.432	Bacillus licheniformis	0.58	Bacillus clausii	0.079		<i>Bacillus clausii</i>
			Bacillus pumilus	0.396	N/A	N/A				
			Bacillus clausii	0.353	N/A	N/A				
25	Talil Airbu	No	Not sent to MIDI	N/A	Not Extracted	N/A	Kurthia gibsonii	0.061		<i>Kurthia gibsonii</i>
							Salinibacillus marismortui	0.069		
							Bacillus informus	0.05		
26	Talil Airbu	No	Bacillus (no 16S match to kr)	0.831	Micrococcus lylae	0.359	Bacillus firmus	1.87%	Genus: <i>Bacillus firmus</i>	
			Arthrobacter viscosus	0.546	Bacillus licheniformis	0.223				
29	Talil Airbu	No	Staphylococcus epidermidis	0.917	Staphylococcus kloosii	0.639	Agronmyces rhizospherae	0.011		<i>Staphylococcus kloosii</i>
			Staphylococcus epidermidis	0.78	Staphylococcus haemolyticus	0.513				
			Staphylococcus epidermidis	0.779	Staphylococcus capsul ureolytic	0.464				
30	Talil Airbu	Beta on blood	Bacillus atrophaeus	0.872	Bacillus subtilis	0.422	No Match	Bacillus mojavensis	0.00% Species: <i>Bacillus mojavensis</i>	
			Bacillus subtilis	0.703	N/A	N/A				
31	Talil Airbu	See #29 and	Bacillus licheniformis	0.612	Not Extracted	N/A	Bacillus licheniformis	1.87%	Genus: <i>Bacillus licheniformis</i>	
			Bacillus pumilus	0.605						
			Bacillus subtilis	0.432						
32	Talil Airbu	See #29 and	Not sent to MIDI	N/A	Not Extracted	N/A	Flavimonas oryzihabitans	0.10%	Species: <i>Flavimonas oryzihabitans</i>	

Microbiology Summary										
17	Udairi	Beta/Alpha	Paenibacillus thiaminolyticus	0.534	Not Extracted	N/A	Paenibacillus thiaminolyticus	2.97%	Genus: <i>Paenibacillus thiaminolyticus</i>	
			Bacillus atrophaeus	0.464						
18	Udairi	Beta hemolyt	Bacillus subtilis	0.901	Bacillus subtilis	0.52	Bacillus vedderi	0.656		<i>Bacillus vedderi</i>
			Bacillus atrophaeus	0.697	N/A	N/A	Bacillus mojavensis	0.642		
							Bacillus atrophaeus	0.471		
19	Udairi	Beta/Alpha	Bacillus subtilis	0.918	Not Extracted	N/A	Bacillus subtilis subtilis	0.00%	Species: <i>Bacillus subtilis subtilis</i>	
			Bacillus atrophaeus	0.687						
20	Udairi	alpha hemolyt	Pantoea agglomerans	0.82	Pantoea agglomerans	0.623	Ralstonia eutropha	0.274	Pantoea agglomerans	0.85% Species: <i>Pantoea agglomerans</i>
			Pantoea agglomerans	0.711	Aeromonas hydrophila	0.356	Burkholderia gaviniense	0.175		
			Salmonella typhimurium	0.683		N/A	Ralstonia basiliensis	0.166		
21	Udairi	No	Not sent to MIDI	N/A	Not Extracted	N/A	Pseudomonas pseudoalcaligenes	0.77%	Species: <i>Pseudomonas pseudoalcaligenes</i>	
22	Udairi	No	Cryptococcus albidus	0.89	Not Extracted	N/A	Cryptococcus albidus	0.00%		<i>Cryptococcus albidus</i>
			Cryptococcus neoformans	0.888						
23	Udairi	No	Bacillus alcalophilus	0.432	Bacillus licheniformis	0.58	Bacillus clausii	0.079		<i>Bacillus clausii</i>
			Bacillus pumilus	0.396	N/A	N/A				
			Bacillus clausii	0.353	N/A	N/A				
25	Talil Airbu	No	Not sent to MIDI	N/A	Not Extracted	N/A	Kurthia gibsonii	0.061		<i>Kurthia gibsonii</i>
							Salinibacillus marismortui	0.069		
							Bacillus informus	0.05		
26	Talil Airbu	No	Bacillus (no 16S match to kr)	0.831	Micrococcus lylae	0.359	Bacillus firmus	1.87%	Genus: <i>Bacillus firmus</i>	
			Arthrobacter viscosus	0.546	Bacillus licheniformis	0.223				
29	Talil Airbu	No	Staphylococcus epidermidis	0.917	Staphylococcus kloosii	0.639	Agronmyces rhizospherae	0.011		<i>Staphylococcus kloosii</i>
			Staphylococcus epidermidis	0.78	Staphylococcus haemolyticus	0.513				
			Staphylococcus epidermidis	0.779	Staphylococcus capsul ureolytic	0.464				
30	Talil Airbu	Beta on blood	Bacillus atrophaeus	0.872	Bacillus subtilis	0.422	No Match	Bacillus mojavensis	0.00% Species: <i>Bacillus mojavensis</i>	
			Bacillus subtilis	0.703	N/A	N/A				
31	Talil Airbu	See #29 and	Bacillus licheniformis	0.612	Not Extracted	N/A	Bacillus licheniformis	1.87%	Genus: <i>Bacillus licheniformis</i>	
			Bacillus pumilus	0.605						
			Bacillus subtilis	0.432						
32	Talil Airbu	See #29 and	Not sent to MIDI	N/A	Not Extracted	N/A	Flavimonas oryzihabitans	0.10%	Species: <i>Flavimonas oryzihabitans</i>	

Summary of Soil Isolates

Best ID thus Far	Comment
<i>Neisseria meningitidis</i>	meningitis
<i>Staphylococcus aureus</i>	cystic fibrosis
<i>Bacillus circulans</i>	gastro-enteritis
NONE	Unidentified
<i>Pantoea agglomerans</i>	septic arthritis
<i>Pseudomonas agrici</i>	
<i>Ralstonia paucula</i>	opportunist-septicemia, peritonitis, abscesses
<i>Staphylococcus pasteurii</i>	various infections
<i>Arthrobacter crystallopoietes</i>	
<i>Pseudomonas balearica</i>	cystic fibrosis
<i>Paenibacillus thiaminolyticus</i>	bacteremia
<i>Bacillus vedderi</i>	obligate alkaliphile
<i>Bacillus subtilis</i>	
<i>Pantoea agglomerans</i>	epiphyte
<i>Pseudomonas pseudocaligenes</i>	
<i>Cryptococcus albidus</i>	septicemia and meningitis
<i>Bacillus clausii</i>	Oral bacteriotherapy
<i>Kurthia gibsonii</i>	Diarrhea
<i>Bacillus firmus</i>	alkaliphile; bread spoilage
<i>Staphylococcus kloosii</i>	various infections
<i>Bacillus mojavensis</i>	biosurfactant
<i>Bacillus licheniformis</i>	food poisoning
<i>Pseudomonas oryzihabitans</i>	Hickman catheter biofilm



Culturettes



Isolates of Concern - Hemolytic

Isolate Number	Location	Culturette	Hemolytic	Genus and Species Identification							
				16S	Match	CLIN 40	Match	Sentinel	Match	TSB	Match
56	Kuwait 2	Blue	Beta	Submitted		Legionella jordanis	0.16	Microbacterium luteolum	0.25	Microbacterium-liquefaciens*	0.42
69	Kuwait 2	Black	Beta	Submitted		Micrococcus luteus C	0.80	Arthrobacter luteolus	0.49	Arthrobacter-atrocyaneus	0.69
70	Kuwait 2	Blue	Beta	Submitted		Micrococcus luteus C	0.81	Arthrobacter luteolus	0.54	Arthrobacter-atrocyaneus	0.68
72	Kuwait 2	Blue	Beta	Submitted		Tatlockia micdadei*	0.26	Arthrobacter oxydans	0.04	NO MATCH	
I-10	Udari	Orange	Alpha	Pantoea agglomerans	0.95	Neisseria cinera	0.20	Providencia rettgeri	0.02	Ewingella americana	0.78
I-11	Udari	Blue	Alpha	Pseudomonas agrici	0.01	No data		No data		Pseudomonas stutzeri	0.90
I-17	Udari	Black	Alpha/Beta	Paenibacillus thiaminolyticus	0.03	No data		No data		Paenibacillus thiaminolyticus	0.53
I-18	Udari	Orange	Beta	Submitted		Bacillus subtilis	0.52			Bacillus subtilis	0.90
I-19	Udari	Blue	Beta/Alpha	Bacillus subtilis subtilis	0.00	No data		No data		Bacillus subtilis	0.92
I-20	Udari	Green	Alpha	Pantoea agglomerans	0.01	Pantoea agglomerans	0.62	Ralstonia paucula	0.27	Pantoea agglomerans	0.82
I-30	Talil AB	Orange	Beta	Bacillus mojavensis	0.00	Bacillus subtilis	0.42	No Match		Bacillus atrophaeus	0.87
I-31	Talil AB	Blue	Beta	Bacillus licheniformis	0.02	No data		No data		Bacillus licheniformis	0.61
I-32	Talil AB	Green	Beta	Flavimonas oryzihabitans	0.00	No data		No data		No data	



Culturettes



Isolates of Concern – Potential Pathogenic species

Update of Recent Data

ID	MIDI CLIN40 ID	Associated Disease
1	Listeria-monocytogenes	0.11 septicaemia, meningitis, intra-uterine infection, enteric infection
7	Tatlockia-micdadei	0.10 Pittsburgh pneumonia agent
16	Legionella-brunensis	0.15 Legionella??
22	Legionella-jamestowniensis	0.12 Legionella??
22	Legionella-jordanis	0.06 legionaires' disease, Pontiac fever (seldom reported unless L. pneumophila and L. micdadei)
23	Leclercia-adecarboxylata	0.42 bacteraemia, wound infection
31	Bacillus-megaterium	0.17 pneumonia, meningitis, endocarditis, bacteraemia, lung infection
32	Pseudomonas-stutzeri	0.21 bacteraemia, UTI, endocarditis, meningitis, CAPD peritonitis
36	Microoccus-luteus-GC subgroup C	0.14 bacteraemia, endocarditis, septic arthritis
36	Bacillus-circulans	0.19 pneumonia, meningitis, endocarditis, bacteraemia, lung infection
37	Bacillus-coagulans	0.19 pneumonia, meningitis, endocarditis, bacteraemia, lung infection
39	Pseudomonas-stutzeri	0.16 bacteraemia, UTI, endocarditis, meningitis, CAPD peritonitis
45	Microoccus-luteus-GC subgroup C**	0.70 bacteraemia, endocarditis, septic arthritis
47-2	Tatlockia-micdadei*	0.10 Pittsburgh pneumonia agent



B-D Crystal Biochemical Characterization of Hemolytic Isolates



Sample	Gram + Organism	Confidence	Associated Disease
#25	Kytococcus sedentarius	0.467	Pitting of human epidermis in keratolysis
#36	Kocuria rosea	0.9927	Catheter related bacteraemia
#72	No Match	*	
#56	Gardnerella vaginalis	0.9982	Human bacterial vaginosis
#69	Leifsonia aquaticum	0.9999	Rare bacteraemia
#22	Leifsonia aquaticum	0.9941	Rare bacteraemia
#16	Corynebacterium pseudotuberculosis	0.6877	Ventral lymphadenitis, abscesses, and ulcerative dermatitis in cattle
#70	Leifsonia aquaticum	0.9951	Rare bacteraemia



Sample	Gram neg. Organism	Confidence	Comments
#22	No Match	*	Additional testing required to establish ID
#16	No Match	*	Additional testing required to establish ID
#36	Yersinia pestis	0.9384	*
#25	Pseudomonas stutzeri	0.8598	Supplemental testing recommended
#69	No Match	*	Additional testing required to establish ID
#72	No Match	*	Additional testing required to establish ID
#56	No Match	*	Additional testing required to establish ID
#70	No Match	*	Additional testing required to establish ID

Bacteria Isolated from Kuwait and Iraq: Demonstrated Antibiotic Resistance.

Culture#	Description	Location	Culturette	Hemolysis	Colony Morphology	MIDI @ DE Environmental	Similarity Index	Comment
8	BSS I	Babylon	Green	No	Dry Fungal type colonies; White spreader on TSA & Blood	Bacillus circulans	0.61	N/A
12	>20-44 μ m	Udairi	Green	No	Cream colored mucoid colonies on Blood and TSA;	Not growing when others sent off	N/A	N/A
16	>44-63 μ m	Udairi	Green	No	Small mucoid colonies on Blood; Spreading mucid on TSA;	Staphylococcus warneri	0.881	N/A
20	>44<90 μ m	Udairi	Green	alpha	Small dry cream colored colonies	Pantoea agglomerans	0.82	GC subgroup B
24	<20 μ m	Udairi	Green	No	Shiny yellowish/cream spreading colonies on TSA; Purple spreader on Blood;	Pantoea agglomerans	0.711	GC subgroup C
28	TAB II Sand A	Talil	Green	No	Large shiny mucoid colonies	Not sent to MIDI	N/A	N/A
32	TAB II Sand B	Talil	Green	beta	Clear white cauliflower colony on TSA; Shiny clear runny colony on Blood;	Not sent to MIDI	N/A	N/A
Culture#	MIDI @ MS CLSI 40	Similarity index	Comment	MIDI @ MS Sentinel	Similarity Index	MIDI 500 bp rDNA sequence analysis % Diff	Comments	
8	No match/Too dilute	N/A	N/A	No match				
12	Vibrio alginolyticus Aeromonas hydrophila	0.366 0.366	N/A N/A	Ralstonia paucula Erwinia malotivora	0.127 0.103			
16	Pseudomonas stutzeri	0.44	N/A	Pseudomonas baleensis	0.097			
20	Pantoea agglomerans Aeromonas hydrophila	0.623 0.386	ICsubgroup N/A	Ralstonia paucula Buttiauxella gaviniæ	0.274 0.175	Pantoea agglomerans	0.85%	Plant/Human Pathogen
24								
28	Not Extracted	N/A	N/A					
32	Not Extracted	N/A	N/A			Plasmimonas oryzihabitans	0.10%	Hickman Cath. Pathogen

*Highlighted rows denote hemolytic species.



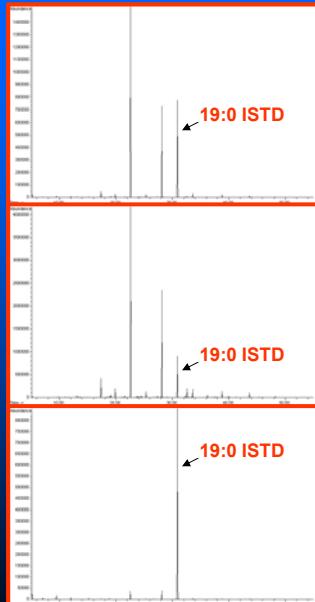
Fungal Isolates



~300 bp of D2 region of LSU rDNA

Microseq Library database Midi D2(300 bp)LSU rRNA	% diff	LSU D2 Genbank Database	% ID	Associated Disease		
Allertia eureka	0.31	Ulocladium sp.	99			
Allertia eureka	4.64	Cryptococcus uzbekistanensis	100			
Allertia eureka	0.31	Ulocladium sp.	99	None		
Altemaria alternata	0	Altemaria sp.	100	Plant pathogen		
Rhodotorula minuta	5.73	Rhodotorula minuta	99	Eye infections		
Cryptococcus albidus	2.44	Cryptococcus sp.	100	Cryptococcus neoformans - meningoencephalitis		
Ulocladium chartarum	0.31	Stemphylium sp	99	Fungal biocontrol agent		
Filobasidium uniguttulatum	4.64	Cryptococcus uzbekistanensis	100	Teleomorph of Cryptococcus, non pathogenic yeast		
Ulocladium consortiale	0	Stemphylium sp	100	cutaneous mycoses		
Ulocladium chartarum	0.31	Stemphylium sp	99			
Mortierella polyccephala	7.1	Mortierella polyccephala	92	Pulmonary mycosis in cattle		
Embellisia chlamydospora	0	Ulocladium sp.	99	none		
Filobasidium uniguttulatum	4.64	Cryptococcus uzbekistanensis	100			
Penicillium camemberti	0	Penicillium sp.	100			
Cryptococcus albidus	0	Cryptococcus albidus	100			
Allertia eureka	0.31	Ulocladium sp.	99			
Embellisia chlamydospora	0	Ulocladium sp.	99			
Filobasidium uniguttulatum	4.64	Cryptococcus uzbekistanensis	100			
Embellisia chlamydospora	0	Ulocladium sp.	99			
Filobasidium uniguttulatum	4.64	Cryptococcus uzbekistanensis	100			
Penicillium camemberti	0	Penicillium sp.	100			
Allertia eureka	0.31	Ulocladium sp.	99	Plant pathogen		
Phoma glomerata	0	Phoma herbarum	99			

PLFA Biomass of Iraq Dust Samples



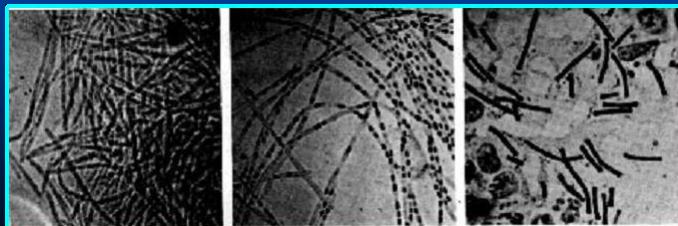
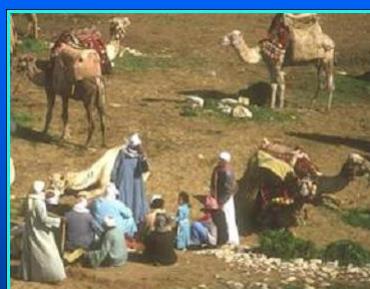
Sample Description	PLFA nmol/g	biomass cells/g
Tent 1 #6A >20 <i>Bacillus cereus</i>	14.6	3.64e11 0.37% (<i>Anthracis</i> ?)

Tent 1 #6A <20 44.3 1.11e12
Bacillus cereus 0.00% (*Anthracis*?)

Tent 2 #6B >20 0.45 1.13e10
Bacillus circulans 0.19%

Summary of the Biological Analysis

- *Hemolytic microorganisms*
- *Gram positive spore-formers*
- *Gram negative opportunists*
- *Fungi*





Conclusions Thus Far



- Relatively abundant microbial community in dust
 - Including PM_{2.5}
- Hemolytic strains isolated/characterized
- Microbial identification systems cause uncertainty
 - B-D Crystal biochemical characterization
 - TLFAME – MIDI CLIN 40, Sentinel TS, MIDI Env
- Methods bias perspective of microbial community
- Need a defensible trigger for concern